Conducting Polymer Actuators (Artificial muscles)

Conducting polymers (CPs) expand and shrink with doping and dedoping, respectively, driven electrochemically, able to be used as actuators. Of the advantages mentioned below, the large electrochemical stress, 10 times larger than that of mammalian skeletal muscle, has been attracting engineers who need powerful actuators. The moderate strain (1-3%) has however been responsible for little attention to put CP actuators to practical use. Recent breakthrough both in electrochemical strain and stress of CP actuators should enhance interest in CP actuators as artificial muscles.

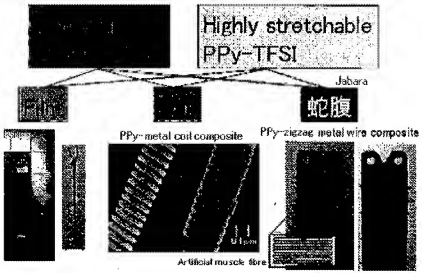
Comparison of EAMEX actuators with others

Actuator	Conventional	Powerful	Extremely stretchable	Muscle
Dopant		$CF_3SO_3^-$	TFSI	
[redacted]	1 - 3	12 - 15	34	20 - 40
[redacted]	3 - 5	49	6 - 10	0.35
[redacted]	0.1	5 (8.8)	13.8	100

[redacted]

[redacted] Bis(trifluoromethylsulfonyl)imide (TFSI)

Overview of EAMEX PPy actuators



Physical and mechanical properties of the EAMEX actuators

Characteristics of the actuators

1. Large strain and stress induced electrically
2. Light in weight
3. Small and simple mechanisms
4. Small electric consumption
5. Sharable to any shape
6. Silent movement
7. Low drive votage (1-2V)

Possible applications of the actuators

1. Robots
2. Powered suits
3. Artificial limbs
4. Medical devices
5. Toys and gadgets
6. Control devices
7. Clients' needs

Fundamendal capability of the powerful polypyrrole actuators

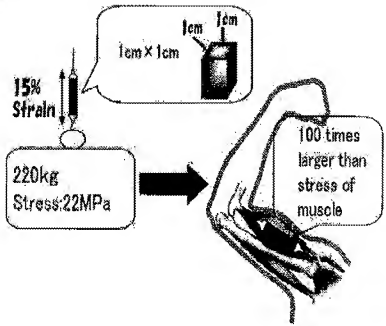
Fundamendal capability of the extremely stretchable polypyrrole actuators

☆Movement model Gips

Fast stretching PPy actuators

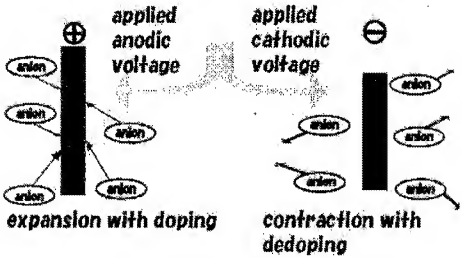
Artificial muscle pump

<Stress>



<Mechanisms of stretching>

- Doping and dedoping of anions
- Conformation change of PPy chains triggered by redox reaction



<Applications>

Applications of PPy actuators to artificial muscles

1. Film Type Actuators
2. Artificial Muscle Pumps
3. Artificial Muscle Fibers
4. Novel Composite Actuator
5. Haptic Display Device